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NASA TT F-332

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REASONS FOR THE LACK OF CORRELATION BETWEEN ATMOSPHERIC DISTURBANCES AND WEATHER CONDITIONS

by V. A. Solov'yev

From *Trudy Glavnoy Geofizicheskoy Observatorii imeni A. I. Voyeykova,* No. 157, 1964

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION • WASHINGTON, D. C. • APRIL 1965

NASA TT F-332

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Translation of "O prichinakh nesootvetstviya atmosferikov s usloviyami pogody."
Trudy Glavnoy Geofizicheskoy Observatorii imeni A. I. Voyeykova,
No. 157, pp. 73-75, 1964.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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REASONS FOR LACK OF CORRELATION BETWEEN ATMOSPHERIC DISTURBANCES AND WEATHER CONDITIONS

V. A. Solov'yev

ABSTRACT

Data from Soviet and foreign scientists on the relation of atmospheric storms and weather conditions are considered. Causes of the lack of correlation of cathode detection and meteorological conditions are considered and evaluated in respect to materials obtained in the USSR.

It is well known that the cathode detection of atmospheric disturbances aids in determining storm source locations. This method consists of the simultaneous (synchronous) detection (by radiogoniometer) by distribution of the azimuths of one or the other atmospheric disturbance at three or four points. Data from the detection points are forwarded to the calculation point, where the locations of individual storm disturbances are determined by azimuths on charts. A group of disturbances, concentrated at one point on the chart, characterize the location and activity of the storm center. Determining storm center locations presents certain errors. Average precision in determining location of individual disturbances is about 5 - 15 percent of the distance from the source of the disturbances. The storm center, consisting of the disturbance pattern, is determined somewhat more precisely than the center of individual disturbances, in $\sqrt{n}$, where n is the number of population columns. Thus, the better the detection of disturbances at the source, the more precise the determination of the storm source location and its activity can be.

Detection in the USSR network of points takes place at eight periods (0, 3, 6, 9, 12, 15, 18 and 21 hrs Moscow time), and the duration of each session was 20 minutes.

Many investigators performed comparison of the data from cathodic detection with weather conditions. H. W. Brockel (ref. 2) states, based on cathodic detection from the American station network located in the eastern part of the country (Red Bank, New Jersey; Gainesville, Florida; and Bermuda), that 67.4 percent of all atmospheric disturbances noted were affirmed by corresponding

weather in a 160 km radius. Special use of the air investigation in the North Atlantic regions indicated that 80 percent of atmospheric disturbances noted were verified by weather conditions in a 160 km radius.

The data of the Japanese investigators Kitagawa, et al. (ref. 2) show that 85 percent of all observed disturbances originate during unstable weather conditions, i.e., cloudiness resulting in precipitation.

On the basis of investigations of Perlat (ref. 3), 44-50 percent of the disturbance sources are related to clearly observed storms. His data show that 60 percent of the disturbance sources were observed on frontal sections of air masses and only 15 percent originate in uniform air masses.

Such characteristics can also be derived from the investigations of the Australian scientists Lloyd (ref. 4) and Phillips (ref. 5).

A more detailed investigation of the relation between the disturbances and weather conditions was drawn from the data of the German scientists Skeib, Kaiser and Popp (ref. 7). Using cathode detection data from the English network, they compared these data with weather charts compiled by the Main Weather Bureau in Potsdam for the months of 1955 and 1956. They concluded that atmospheric disturbance centers correspond to meteorological conditions. These scientists also affirm that if there are disturbances of nonmeteorological origin, they do not have a significant value. The fact that not all storms were encompassed in the detection is explained by the short duration (10 min) of the sessions. A comparatively higher percentage of disturbances in the winter months was attributed to the greater storm activity on the Atlantic in winter than in summer. The German scientists evolved charts of storm tendency by Simila's method (ref. 8), which agreed with data on disturbances, and this, in their opinion, is of practical interest because meteorologists can always follow the locations of unstable regions with data of disturbance measurements.

Reference 1 gives more complete data on the correlation of disturbances to weather conditions. N. I. Leushkin and A. A. Pavlovskaya (ref. 1) showed, from data obtained in 1953-1955, that correlation of measurements of disturbances and intense storm centers in a radius of 250 km was possible in 68 percent of the cases. A clear connection is thus found between the intense storm centers and frontal separations in 90 percent of disturbances related to the fronts located as far away as 200 km. In low pressure areas, storm centers of various intensities (activity) were located in 73 percent of the cases. Storm centers in high-pressure areas (11 percent) were also observed, but in anticyclones, intense disturbance centers were nowhere observed.

Leushkin and Pavlovskaya also believe that cathode detection data can be used in weather forecasting. Thus, if we know the disturbance center location at 05 hrs or 09 hrs, and the direction and wind velocity at the 700-500 mb level for the same times, we can calculate the region in which the unstable weather, and possibly storms, will be located at 15 hours. A check of forecasts compiled in this manner has shown that the region in which the unstable weather and storms, showers, cumulus and thick cumulous clouds were observed during daylight hours (13-17 hrs.) can be determined in 71 percent of cases.

This shows that cathode detection data agree well with meteorological conditions, but there still exist lacks of relationship, whose bases, although generally known, have not been evaluated. We have made an attempt to evaluate them, and in doing so used cathode detection for July 1961 on territory delineated by latitudes from 45° to 64° N and longitudes from 25° to 60° E. For each 5° geographical band from the TM-1 table, observed storms were chosen at meteorological stations located in these bands, with a note of the beginning and end of each storm for every day in July. These data were transferred by R. I. Simonova onto the chart on which all detected atmospheric disturbance centers and meteorological data were noted.

Charts were composed for each day of July. Analysis of the material led to the basis of comparing these data with squares of 250 km radius from the center of the detected disturbances. A total of 852 disturbance sources were observed, and analysis of the material shows that 79 percent confirm network data, and 89.4 percent correspond to conditions on the charts. Thus, 10.6 percent of the disturbance sources were found to be "false." With more detailed observations of the location of these sources, however, it was found that 52 sources, or 6 percent, were located in territory lightly covered by the meteorological network; 30 sources, i.e., about 3 percent, were beyond the limits of the station survey (at distances over 20 km), while 7 sources, less than 1 percent, were not verified by meteorological data due to incompleteness of weather maps in these regions.

Consequently, there are essentially no false disturbance sources. All unverified meteorological data on sources are within the scope of the observers. With the introduction of storm registering devices into the net it is probable that there no longer will be storm sources that do not correspond to weather conditions.

Investigations of storm sources not encompassed by the cathode detection were introduced into storm data for July 1961. It appeared that 20 percent of them passed between the lines of the cathode detection (in a 3 hr interval); 6 percent of the centers passed from active storms near the control points of the cathode detection, and 23 percent from the inadequacy of the detection methods and data evaluation (distant storm sources also located in the limits of the topographical map were used for calculation). Gaps in storm sources will be considerably less if detection is taken hourly, the number of control points is increased, the synchronization of detection is increased, and corresponding topographical maps are constructed on gnomonic projections.

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Translated for the National Aeronautics and Space Administration
by John F. Holman and Co. Inc.

NASA-Langley, 1965 F-332

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